Project Proposal - Team 1

Project Overview

- Portfolio Optimization is used for risk-averse investors to construct portfolios to optimize or maximize expected return based on a given level of market risk, emphasizing that risk is an inherent part of higher reward.
- Use of **Modern Portfolio Theory** to develop the efficient frontier to configure an optimal portfolio set that offers the highest expected return for a defined level of risk or the lowest risk for a given level of expected return
- We can use optimization functions to find the ideal weights of how to distribute the funds allocated to assets in a portfolio.

Class Work: FinTech Bootcamp - Project 1

Project Topic and Title: Modern Portfolio Theory Based Portfolio Analysis and Optimization

Project Team

- Skylizard, Loki 'billie'
- Mandal, Dinesh
- Gavnoudias, Stratis
- Huang, Yan
- Conyea, Will

Project Features/Components/Tasks

1. Brief Introduction of Modern Portfolio Theory Project
    a. Group assignee(s): Dinesh, Stratis
2. Project Scope (business and user needs / acceptance criteria)
    a. Group assignee(s): Team
3. Collection of Stock Data
    a. Data extraction (DowJones/S&P 500, # of years worth of data - 5 years is fine, prediction 1 year into future, etc)
        i. API / Alpaca
        ii. CLI
    b. Data Preparation (missing data, duplicate data, dirty data)
    c. Data storage
        i. CSV files
        ii. SQLite
    d. Group assignee(s): Yan, Will, Dinesh
4. Quantitative Analysis
    a. Components from FinTech class/modules:
        i. Returns metrics, cumulative returns, risk, covariance, standard deviation, beta, rolling metrics/windows
    b. “NEW” Analysis (as a requirement for this project)
        i. Market metrics, correlation coefficient, portfolio analysis, portfolio asset allocation, determining the efficient set/frontier, single-index model, alpha, excess return over beta
    c. Group assignee(s): Stratis, Billie, Yan
5. Performance Evaluation
    a. How well does/did our portfolio perform?
    b. Predict future performance:

        i. Monte Carlo Simulations
        ii. Back-testing
        iii. Evaluate and compare against real world returns.
    c. Group assignee(s): Billie, Will, Yan
6. Presenting the Output(visual presentation)
    a. Beautifying the data / results
    b. Graphs, plots, pictures, heatmaps, etc.
    c. PyViz
    d. Dashboard - Streamlit
    e. This part will include visualization of the above components - i.e. from (3) collection of data; (4) Quantitative Analysis; and (5) Performance Evaluations.
    f. Group assignee(s): Will, Billie, Dinesh
7. README file & Documentation
    a. Recommendation for future work / enhancements.
    b. Group assignee(s): Billie, Dinesh
8. GitHub Project Collaboration
    a. Github Project Management
    b. Project Integration & Testing
    c. Group assignee(s): Dinesh, Team
9. Class Presentation
    a. Group assignee(s): Team

Project Notes/Ideas

- We have 5 members on the team, we should assign a single owner to the above features/tasks, plus an optional 2nd (or more) person to assist, review.
    - We should all review above tasks and pick your owner/participation preference by Sunday's review session
- Each of the above tasks can be implemented in separate python programs (jupyter notebooks) and subsequently be "imported" into the main/master notebook (need to think about how this will be done).
- We have 2 weeks to do this project - what are the milestones? How often should we get together (team/couple on individual tasks, as a group for the full task)?
- Need to make sure our project code includes some fundamental aspects taught in class... e.g. conditional logic, functions (dynamic - pass arguments, return values), for loops / iterators, read/write to csv files, filtering data sets, python modules, git / github, proper commits, data frames (data extraction, filtering rows, columns, etc.), exception handling, MC 5:1 ratio

Resources:

- MPT (thismatter.com)
- MPT (investopedia)
- Agile Methodology (overview)
- Efficient Frontier
- Dispersion (αβ)(investopedia)
- Agile(sprints and scrums)
- Finding CAL/Optimum Port. Frontier
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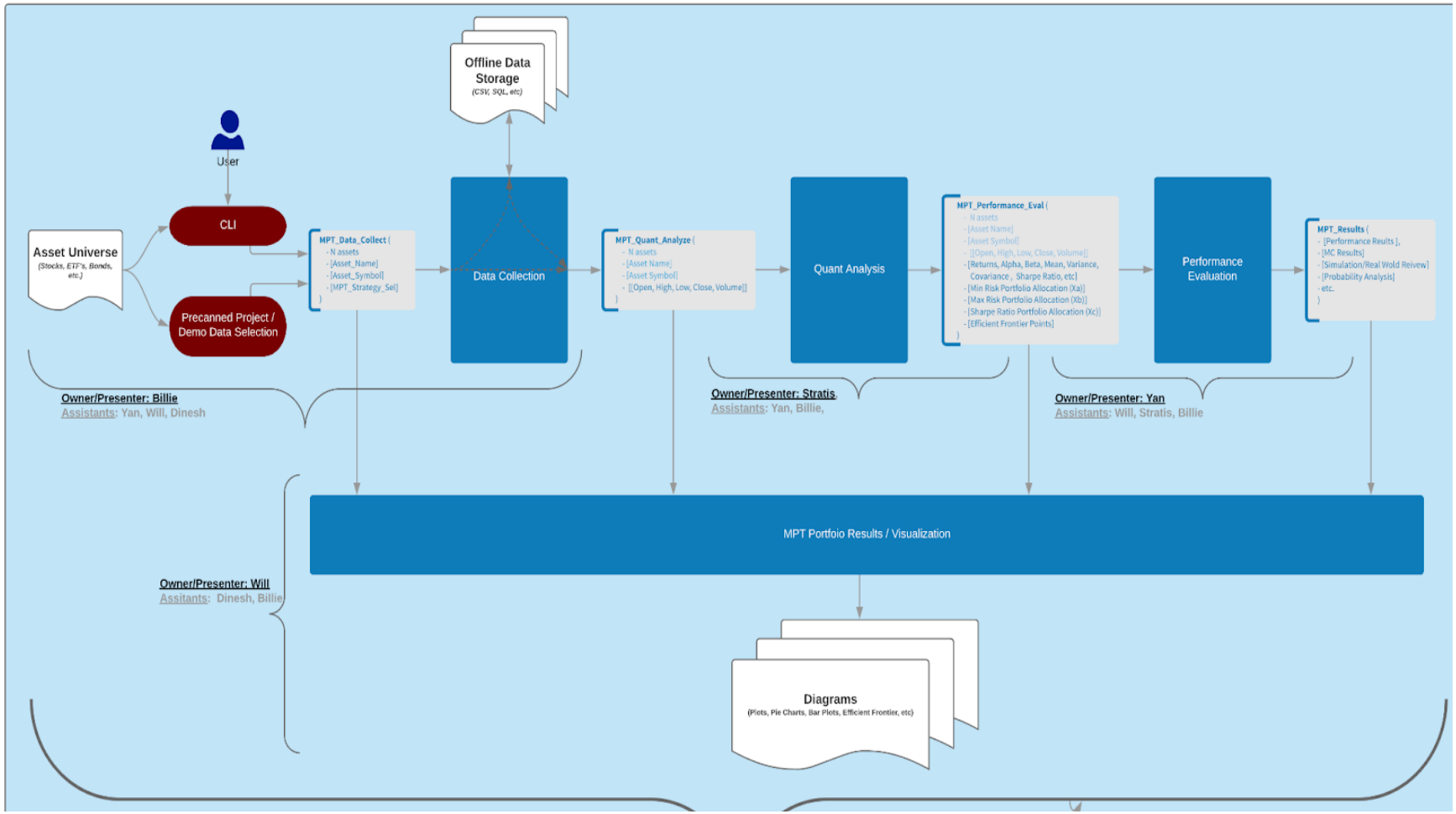


Notes from team discussions following class on 10/6/22:

Portfolio analyzer for MPT

- Groups of assets to find best MPT ratios
    - Based on past ratios

Project Breakdown

- Project Components and Tools
    - Tools/Features
        - Monte Carlo - PyViz
            - Additional libraries
        - Statistical Analysis - Pandas
        - Questionary
        - Alpaca - APIs
        - SQL for data
        - We can also venture out
    - Techniques
        - Quality and Erroneous data
            - Data Cleaning
            - No benchmark for quality data

Task Allocation

- Pairs vs Dividing tasks for individuals
    - Dividing tasks
        - Fixed boundaries
        - Packages
- Code review sessions
- Github

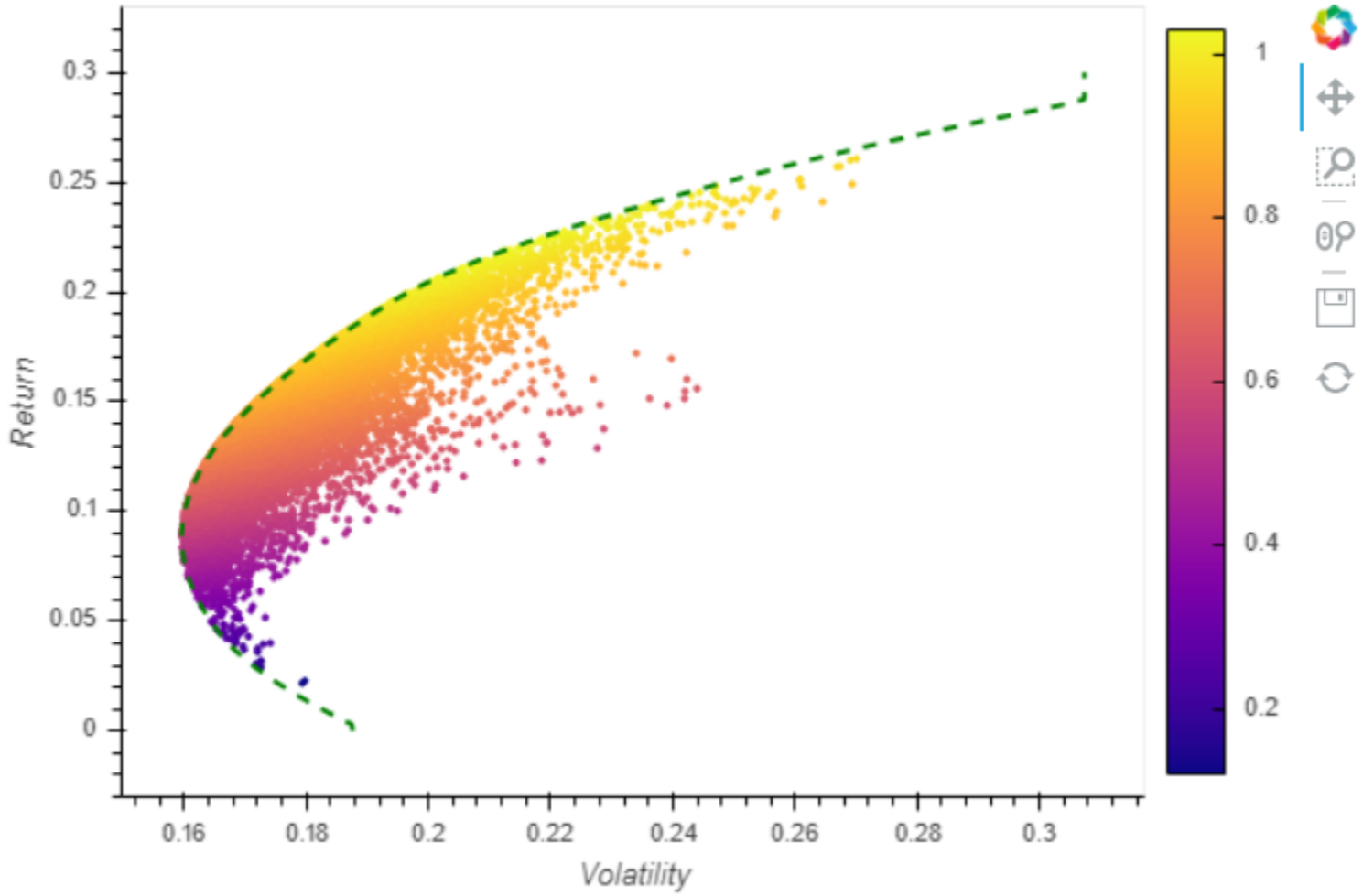
Notes from team discussions after Will on 10/09/22:

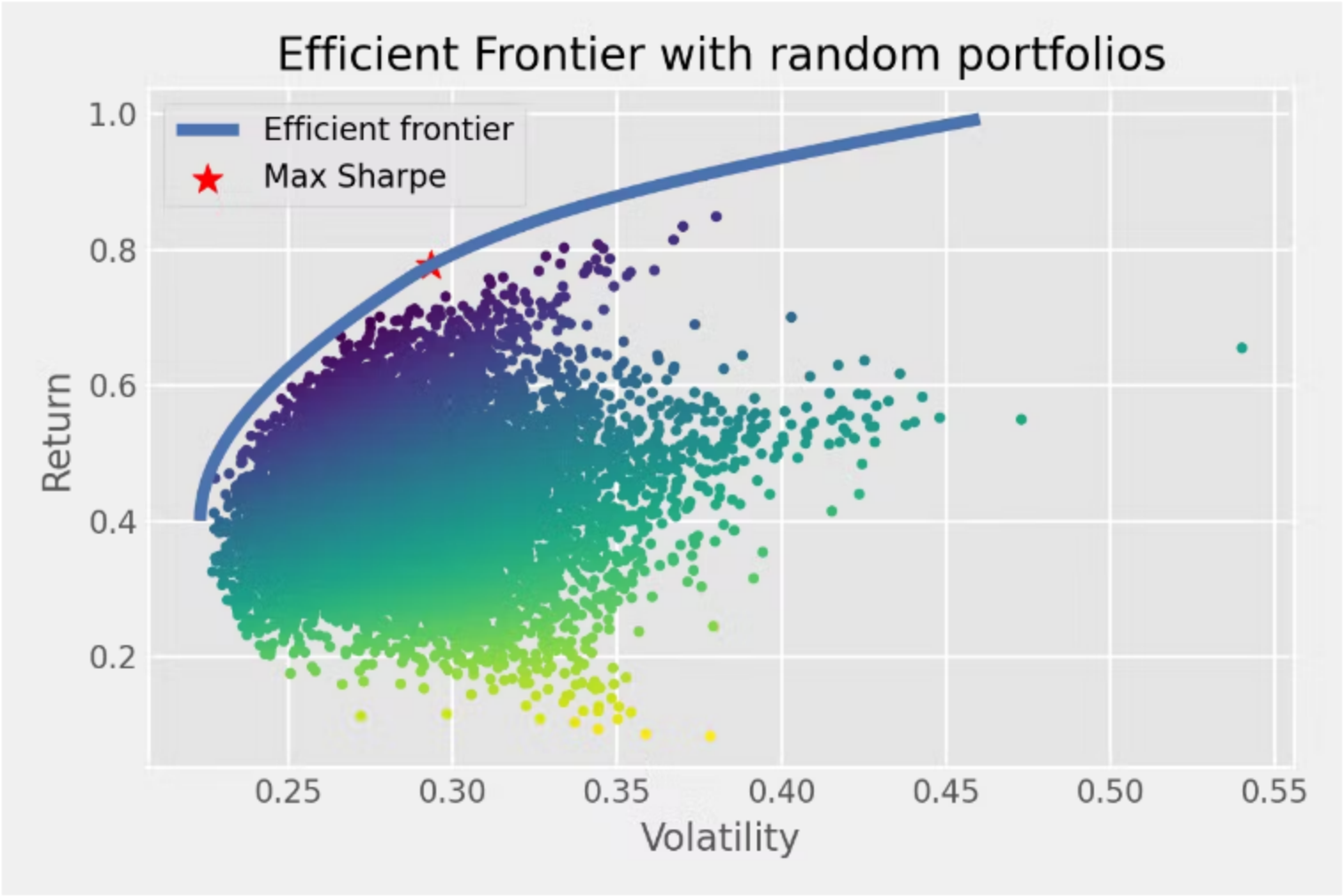
Dinesh will format the project template; all projects will be in sprint/modular format and happen concurrently.

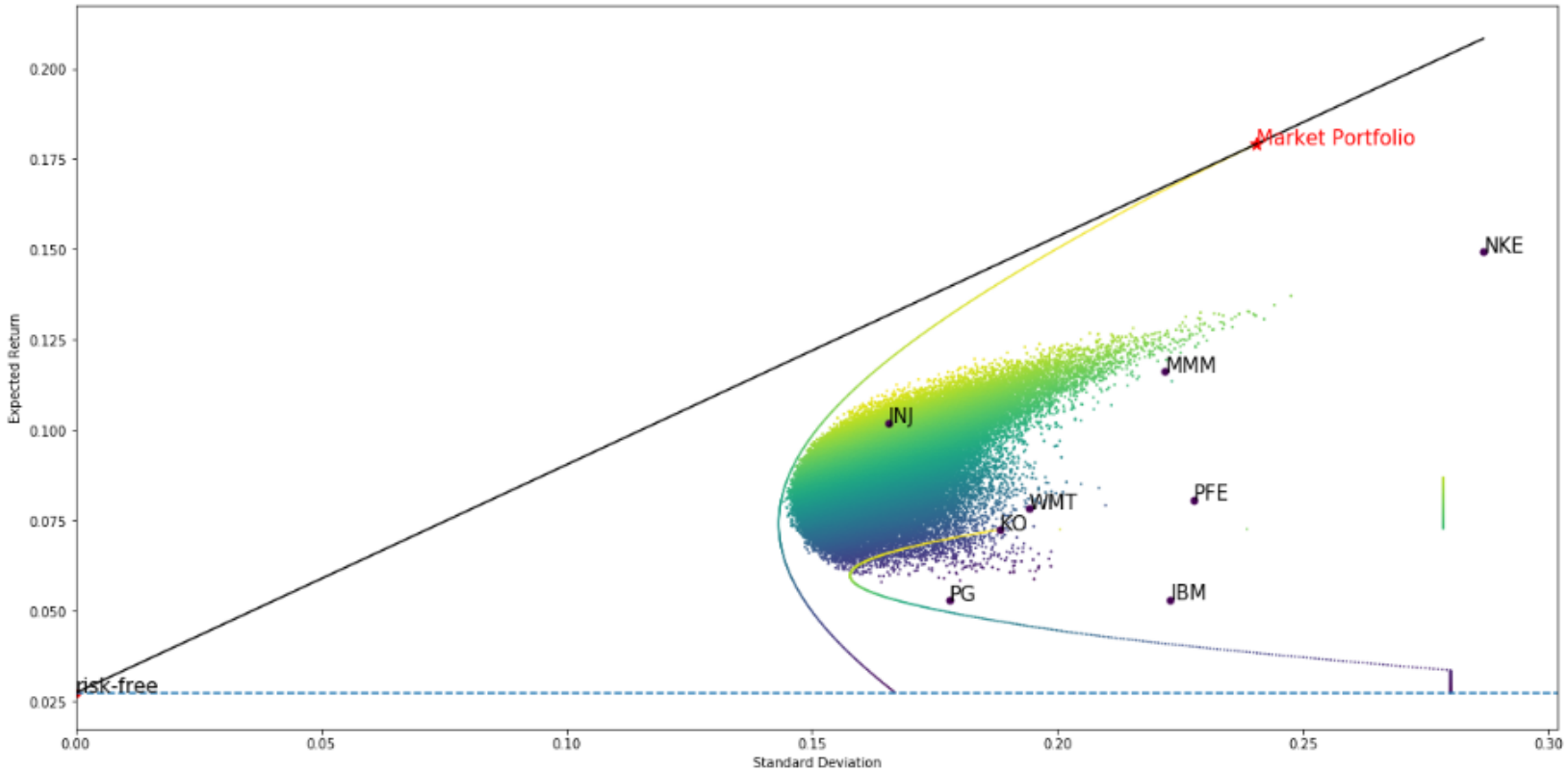
- We will be defining out task blocks.
- Defining input and outputs of each project ‘block’ and how they will pull into each other ‘block’.
- Interactivity of the project
    - Constraining CLI BUT code is broad and modular, nothing hard coded
- Understand that this could just go bad, as in it wont effective

Sample images from internet:

- Efficient Frontier:

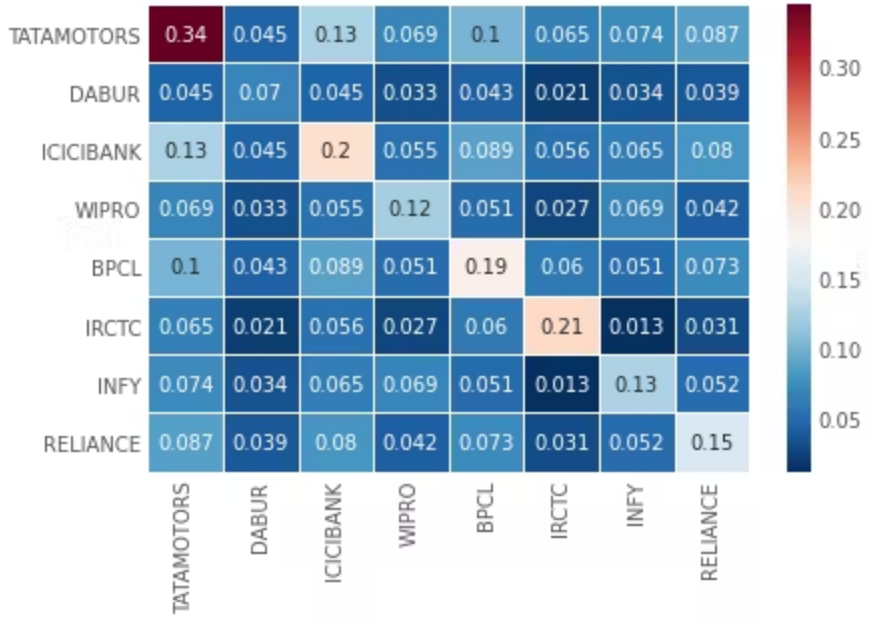



Efficient Frontier with random portfolios
Efficient frontier
Max Sharpe
Return
Volatility
1.0
0.8
0.6
0.4
0.2
0.25
0.30
0.35
0.40
0.45
0.50
0.55



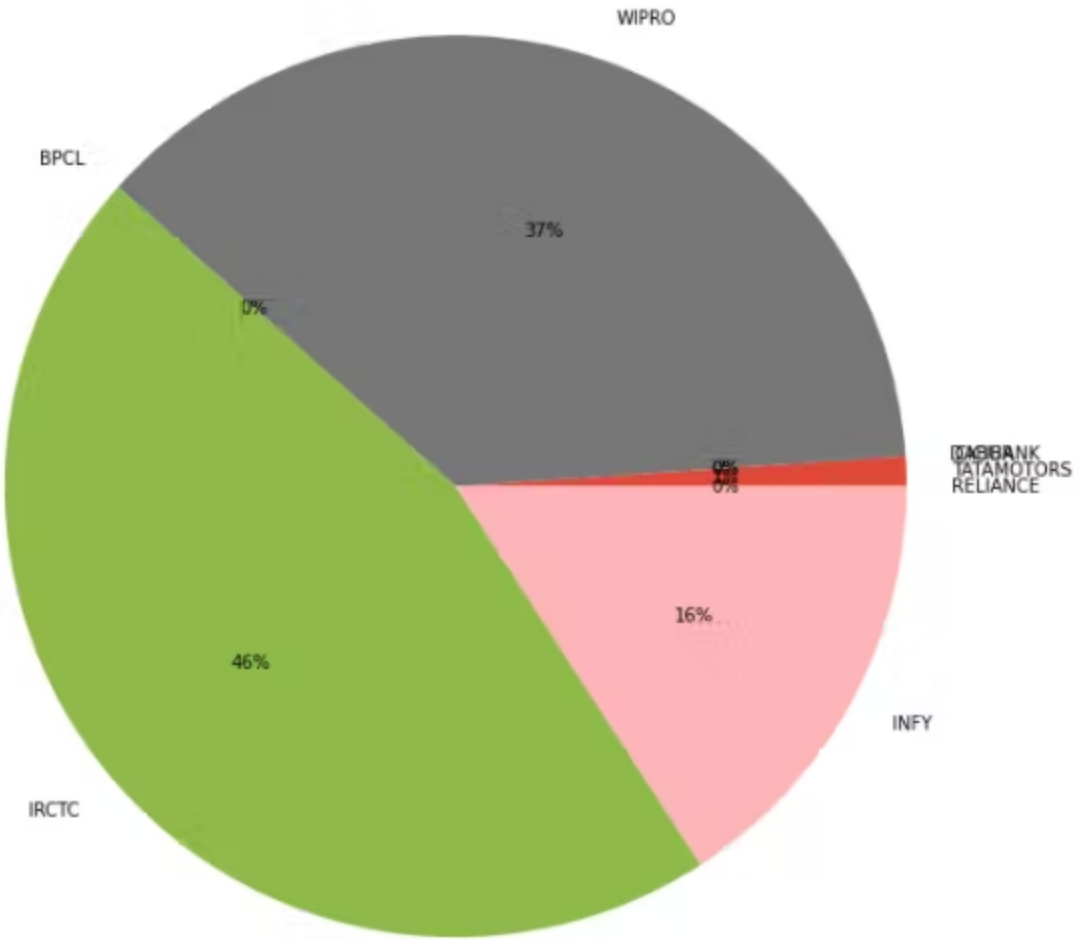
Since we have fewer stocks to choose from, it's not too surprising that our maximum expected return is lower for any level of risk. This demonstrates why diversification is often said to be a "free lunch" in investing.

- Sample heatmap:

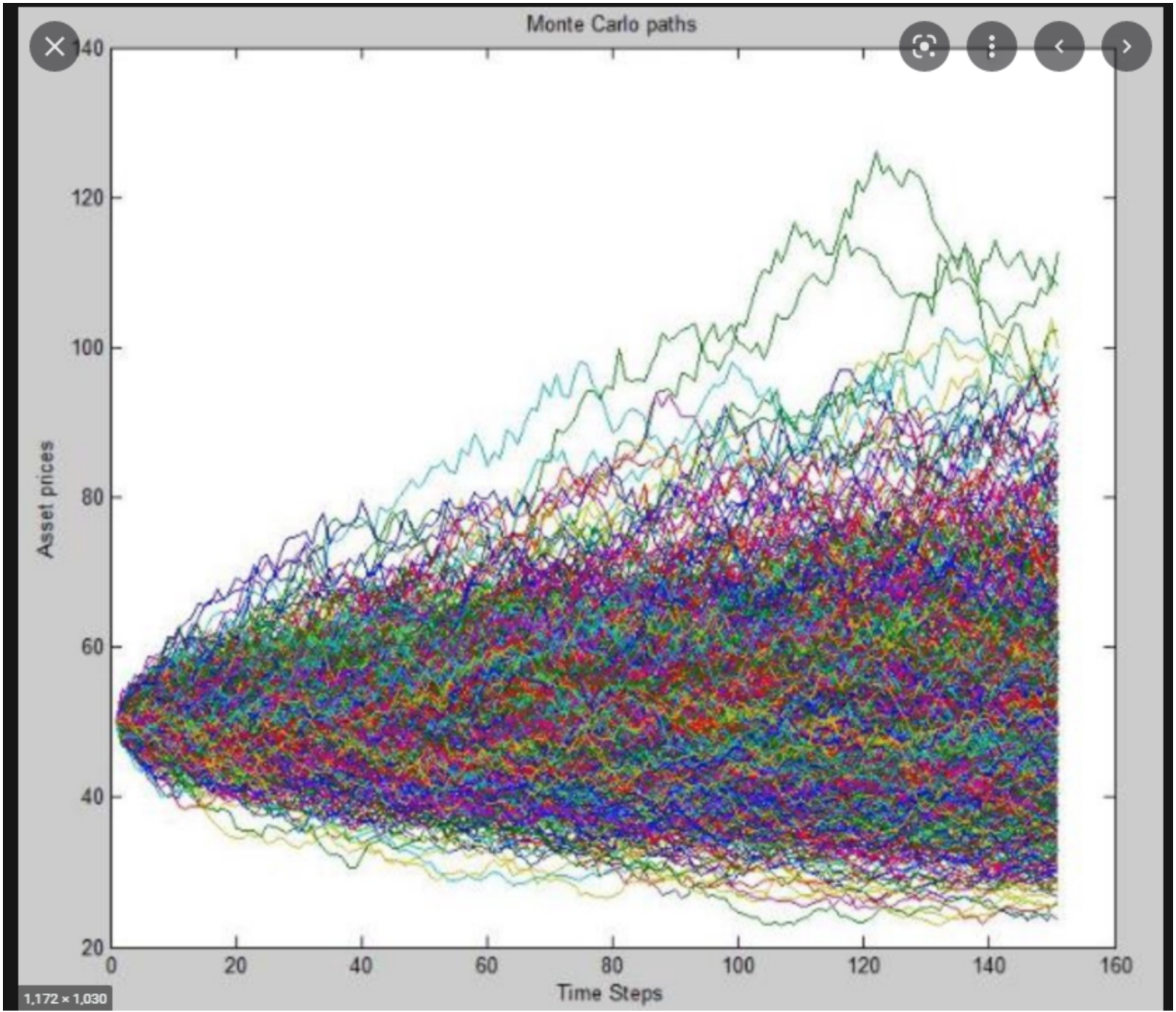


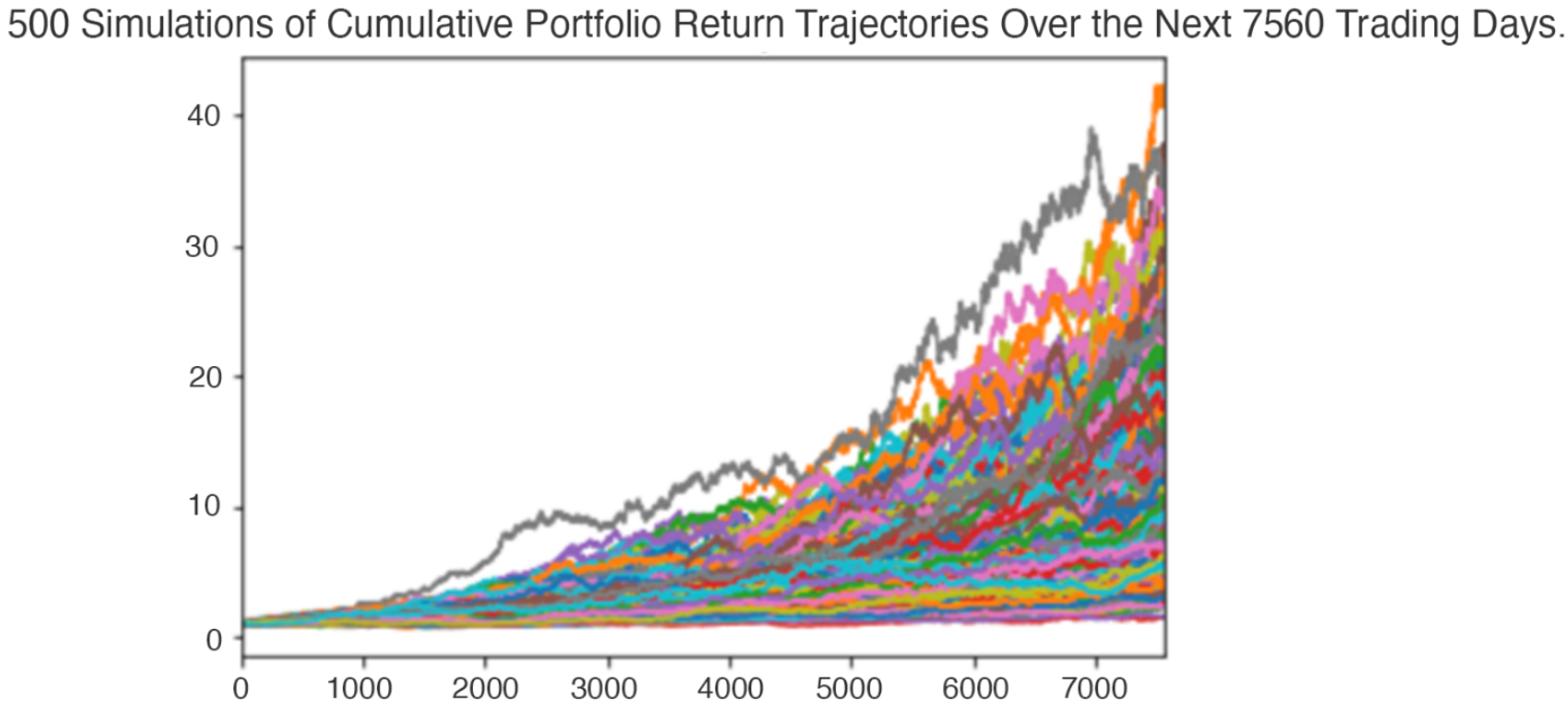
- Sample portfolio allocations

Portfolio Allocation

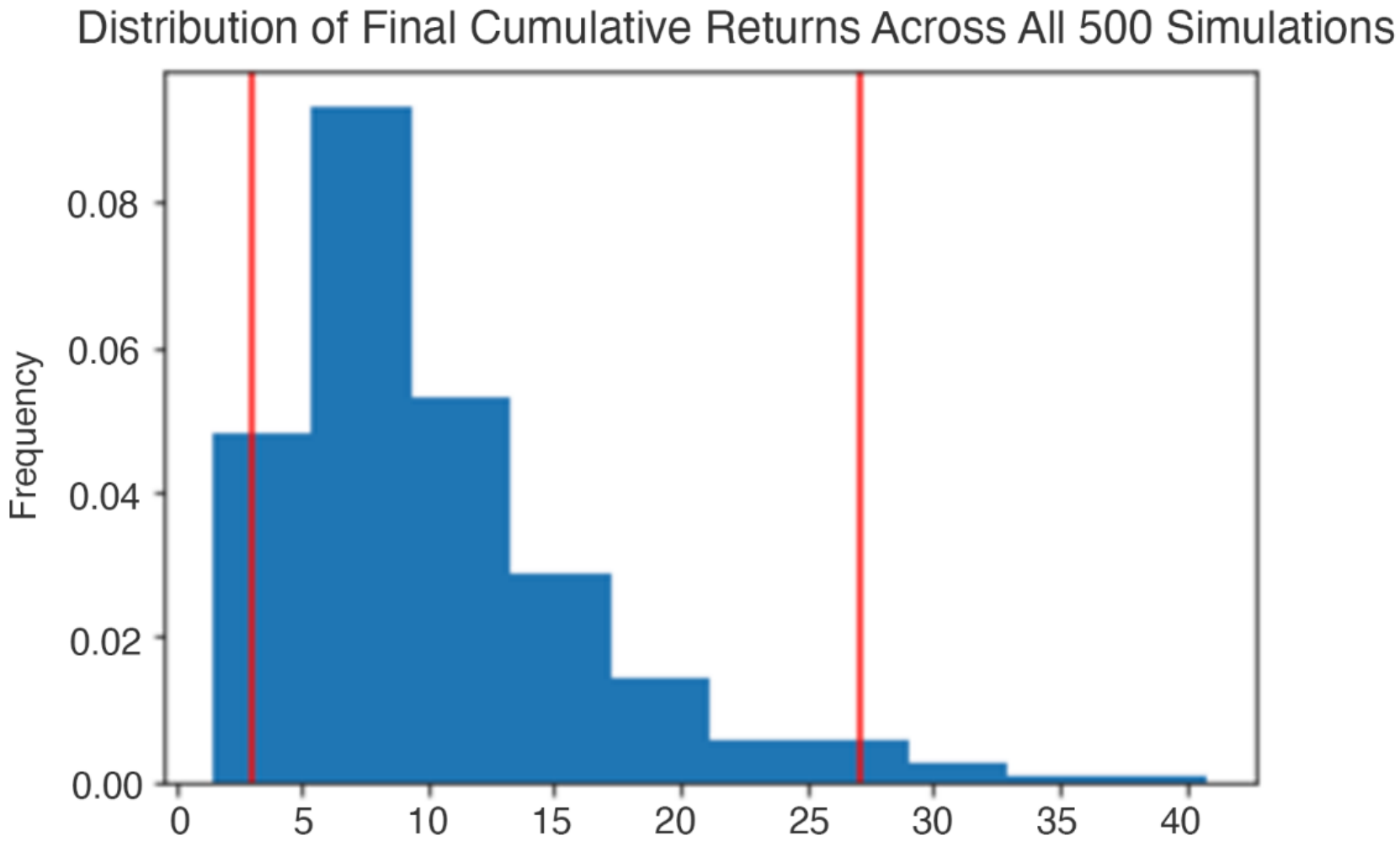


- Sample MC random paths

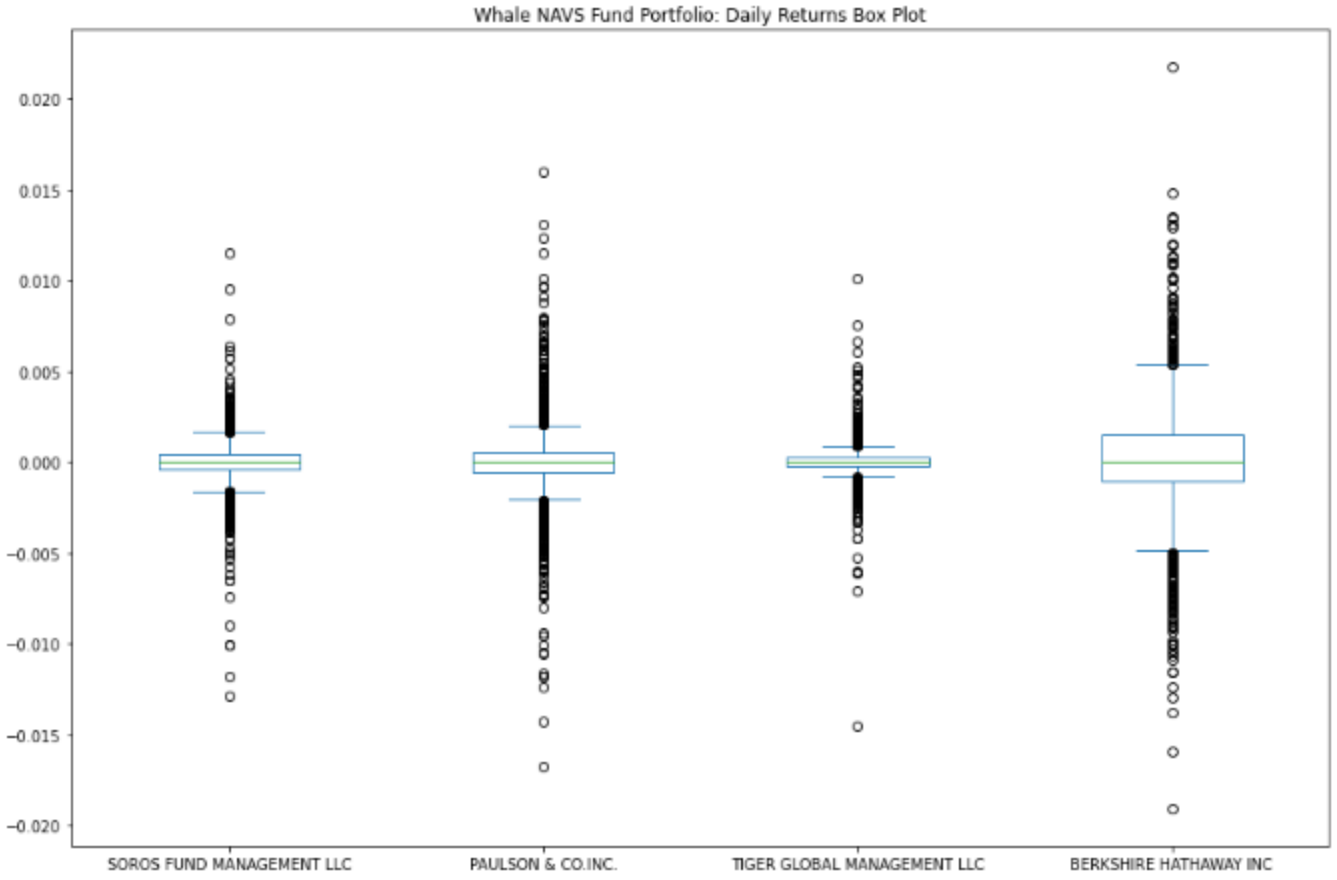

Monte Carlo paths
Asset prices
Time Steps
140
120
100
80
60
40
20
0
20
40
60
80
100
120
140
160
1,172 × 1,030



- Monte carlo distribution results:



- Box plots of distribution


Whale NAVS Fund Portfolio: Daily Returns Box Plot
0.020
0.015
0.010
0.005
0.000
−0.005
−0.010
−0.015
−0.020
SOROS FUND MANAGEMENT LLC
PAULSON & CO.INC.
TIGER GLOBAL MANAGEMENT LLC
BERKSHIRE HATHAWAY INC

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